MITSUBISHI ELECTRIC

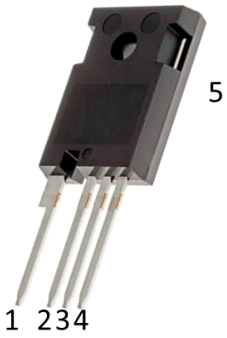
PRELIMINARY

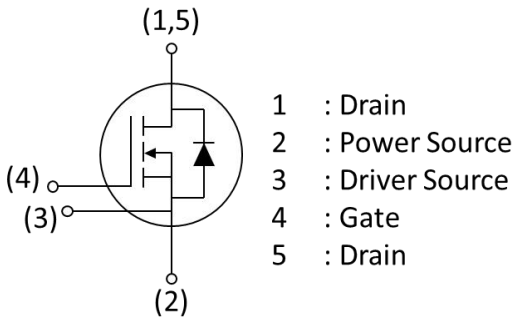
< SiC-MOSFET >

BM040N120K

N series 1200V TO-247-4

TO-247-4





Features

- ✓ Low switching losses
- ✓ High tolerance for capacitive turn-on
- ✓ Fast reverse recovery of body diode
- ✓ Pb-free lead plating (RoHS compliant)

Applications

- ✓ Power factor correction
- ✓ Switch mode power supply
- ✓ Uninterruptible power supply
- ✓ Charging infrastructure
- ✓ Solar inverter

Key Performance

V_{DSS}	1200V
I_D (T_C = 25°C)	66A
$R_{DS(on)}$ (T_j = 25°C)	40mΩ

Packaging Specifications

Part Number	BM040N120K
Package	TO-247-4
Marking	BM040N120K

Maximum ratings (T_j = 25°C, unless otherwise noted)

Item	Symbol	Condition	Rating	Unit
Drain-source voltage	V_{DSS}	-	1200	V
Gate-source voltage	V_{GSS} *1	-	-10/+22	V
Continuous drain current	I_D *2	T_C = 25°C	66	A
		T_C = 100°C	48	A
Pulsed drain current	$I_{D,pulse}$ *3	Limited by T_{jmax}	160	A
Continuous body diode forward current	I_S *2	T_C = 25°C	59	A
Pulsed body diode forward current	$I_{S,pulse}$ *3	Limited by T_{jmax}	120	A
Power dissipation	P_{TOT} *2	T_C = 25°C	319	W
Operating junction temperature	T_j	-	-55 to 175	°C
Storage temperature	T_{stg}	-	-55 to 150	°C
Soldering temperature	T_{sold}	1.6mm from case for 10s	260	°C
Mounting torque	M	-	0.8	N·m

Thermal characteristics

Item	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction-case	$R_{th(j-c)}$ *3	-	0.37	0.47	°C/W

Static characteristics (T_j = 25 °C, unless otherwise noted.)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 10uA	1200	-	-	V
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS} = 15V, I_D = 40A T_j = 25°C T_j = 100°C T_j = 175°C	 - - -	 40 42 53	 60 - -	mΩ
Body diode forward voltage	V_{SD}	V_{GS} = -5V, I_{SD} = 40A, T_j = 25°C	-	4.1	-	V
Gate-source threshold voltage	$V_{GS(th)}$ *4	V_{DS} = 10V, I_D = 4.0mA	1.7	2.3	2.9	V
Drain-source leakage current	I_{DSS}	V_{DS} = 1200V, V_{GS} = 0V	-	0.01	10	uA
Gate – Source leakage current	I_{GSS}	V_{GS} = 22V, V_{DS} = 0V	-	-	100	nA
		V_{GS} = -10V, V_{DS} = 0V	-	-	100	
Transconductance	g_{fs}	V_{DS} = 10V, I_D = 40A	-	18	-	S
Internal gate resistance	$R_{G,int}$	f = 500kHz	-	2	-	Ω
Input capacitance	C_{iss}	V_{DS} = 800V, V_{GS} = 0V, f = 500kHz	-	2600	-	pF
Output capacitance	C_{oss}		-	135	-	
Reverse capacitance	C_{rss}		-	6	-	
C_{oss} Stored Energy	E_{oss}		-	57	-	uJ

Dynamic characteristics (T_j = 25 °C, unless otherwise noted.)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Total gate charge	Q_g	V_{DD} = 800V, I_D = 40A, V_{GS} = -5/15V	-	94	-	nC
Gate to Drain charge	Q_{gd}		-	30	-	
Gate to Source charge	Q_{gs}		-	40	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 800V, I_D = 40A, V_{GS} = -5/15V, $R_{G,ext}$ = 2.2Ω FWD: same type device as D.U.T. at VGS = -5V Inductive load	-	22	-	ns
Rise time	t_r		-	21	-	
Turn-off delay time	$t_{d(off)}$		-	29	-	
Fall time	t_f		-	9	-	
Turn-on switching loss	E_{on}		-	571	-	uJ
Turn-off switching loss	E_{off}		-	134	-	
Body diode reverse recovery charge	Q_{rr}	V_{DD} = 800V, I_S = 40A, di/dt = 5200A/us, V_{GS} = -5V	-	275	-	nC
Body diode reverse recovery time	t_{rr}		-	13	-	ns
Body diode reverse recovery current	I_{rr}		-	35	-	A

*1 Recommended turn-off gate voltage V_{GS_off} is -5~0V.

Recommended turn-on gate voltage V_{GS_on} is 15V.

Use with t_{surge} < 300ns. Do not use with V_{GS_on} < 13V.

V_{GS} Waveform Example

*2 Limited by T_{jmax} and $R_{th(j-c)max}$

*3 Designed value (not tested).

*4 Tested after applying VGS = 20V for 200ms.

Electrical Characteristic Curves

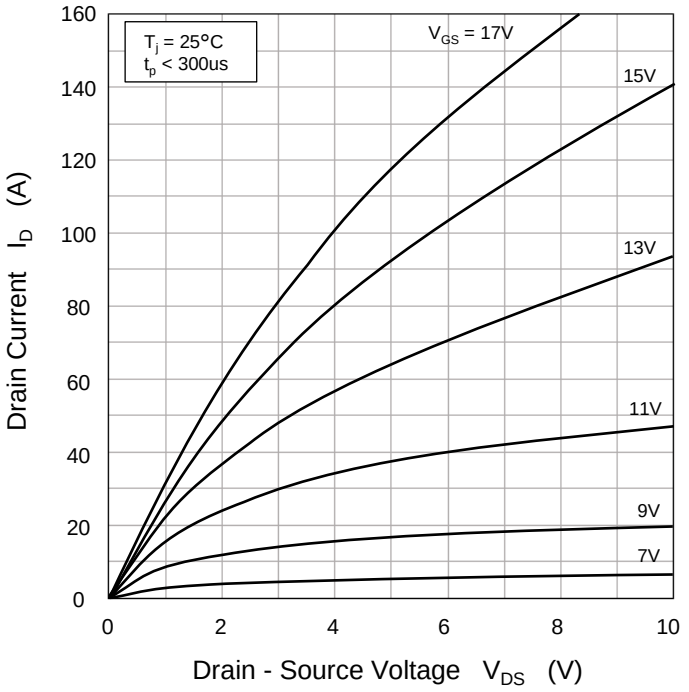


Figure 1 Typical Output Characteristics (T_j = 25°C)

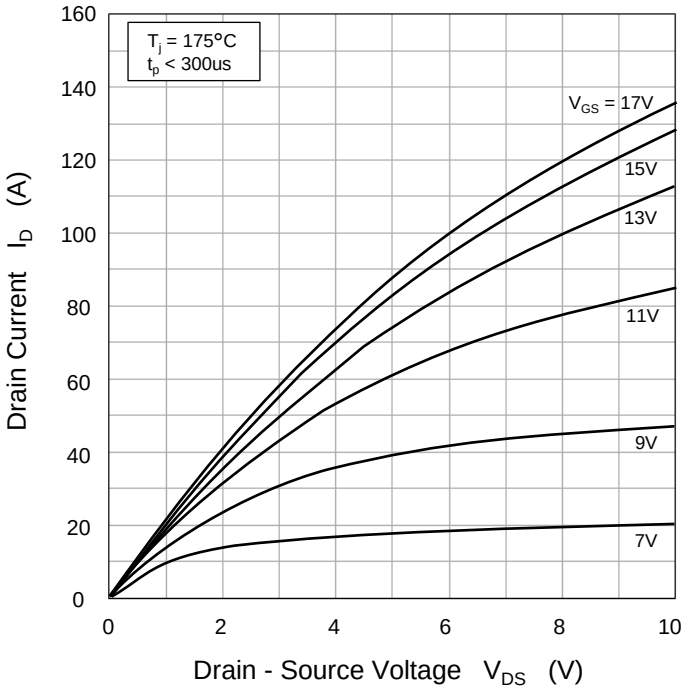


Figure 1 Typical Output Characteristics (T_j = 175°C)

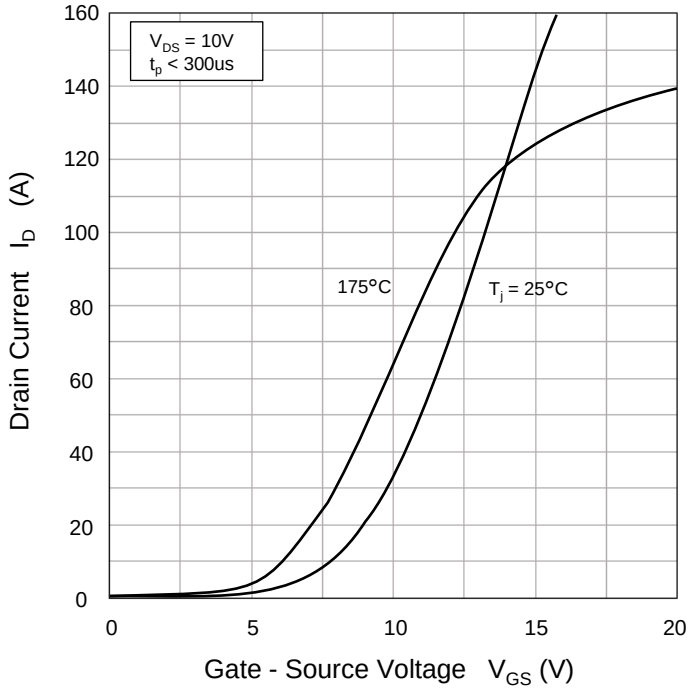


Figure 3 Typical Transfer Characteristics

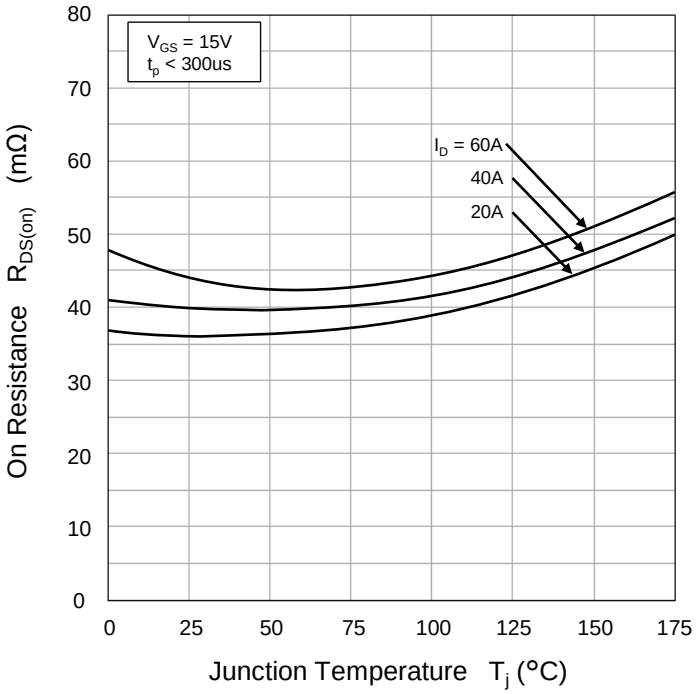


Figure 4 Typical On resistance vs. Junction Temperature

Electrical Characteristic Curves

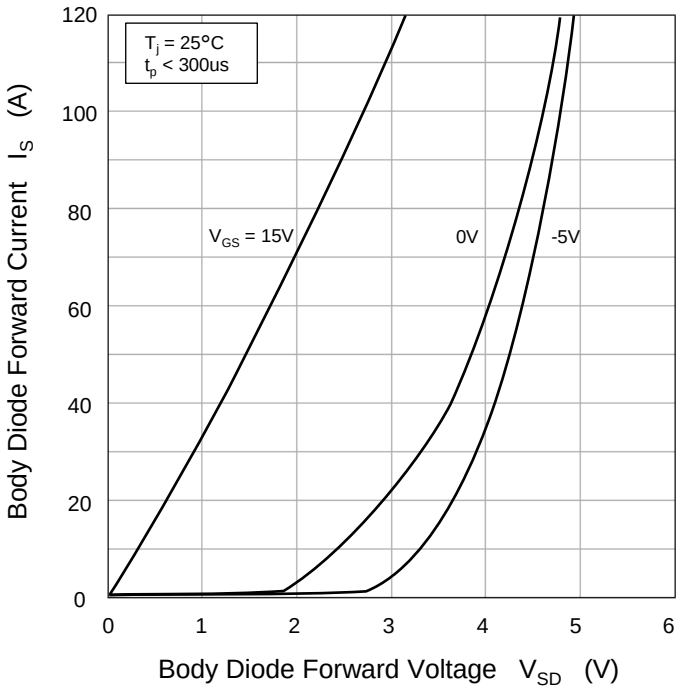


Figure 5 Typical Body Diode Forward current vs. Source-Drain Voltage (T_j = 25°C)

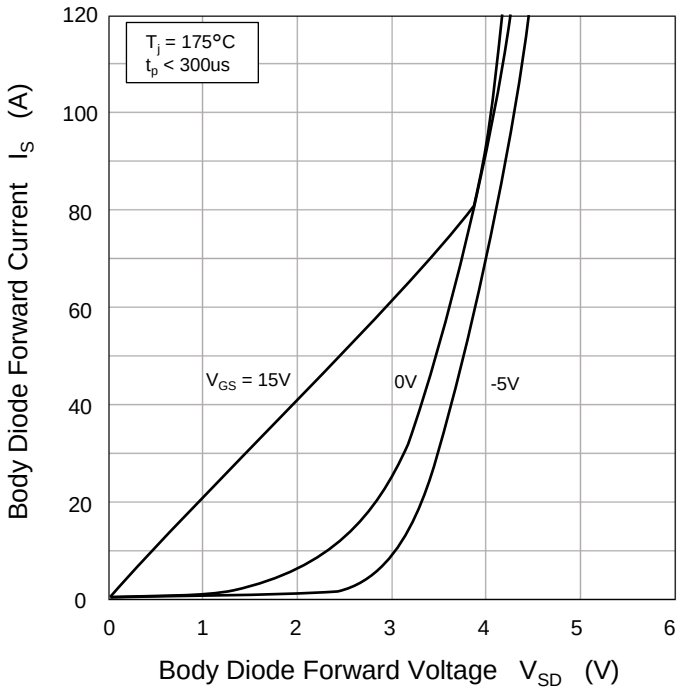


Figure 6 Typical Body Diode Forward current vs. Source-Drain Voltage (T_j = 175°C)

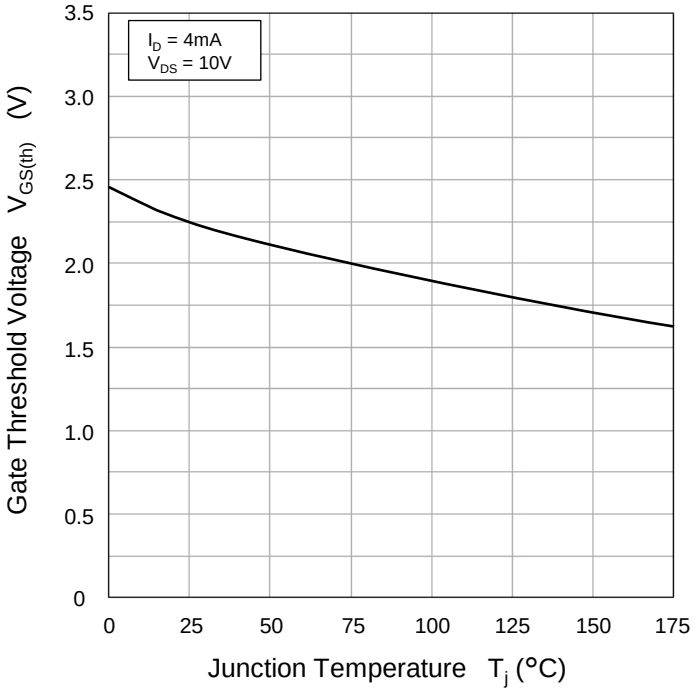


Figure 7 Typical Gate Threshold Voltage vs. Junction Temperature

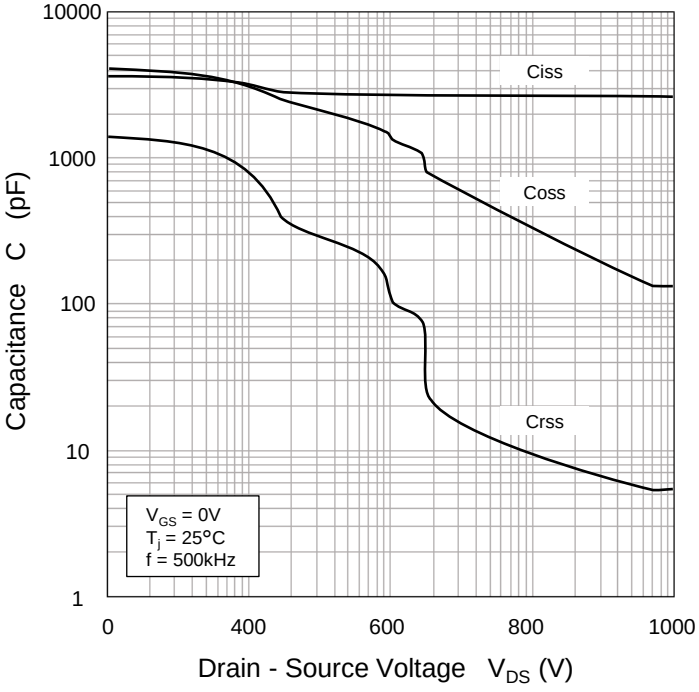


Figure 8 Typical Capacitance vs. Drain-Source Voltage

Electrical Characteristic Curves

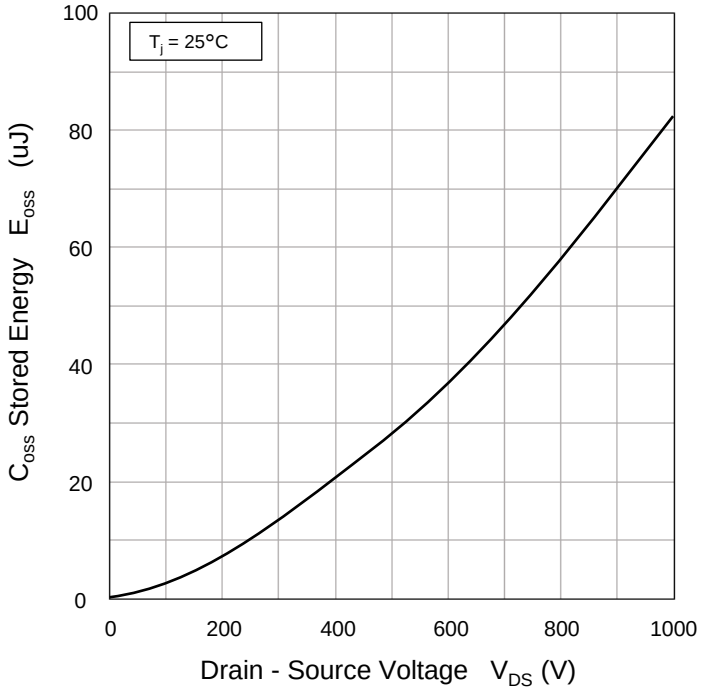


Figure 9 Typical C_{oss} Stored Energy

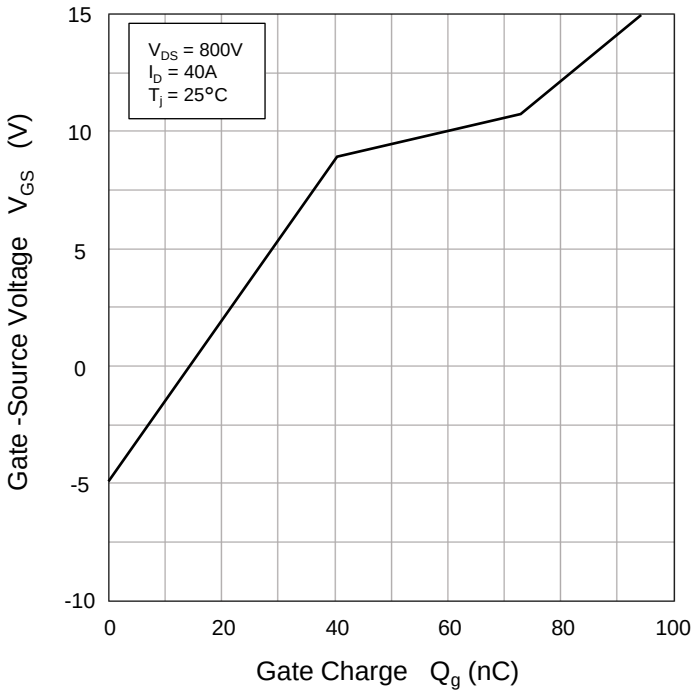


Figure 10 Typical Gate charge Characteristics

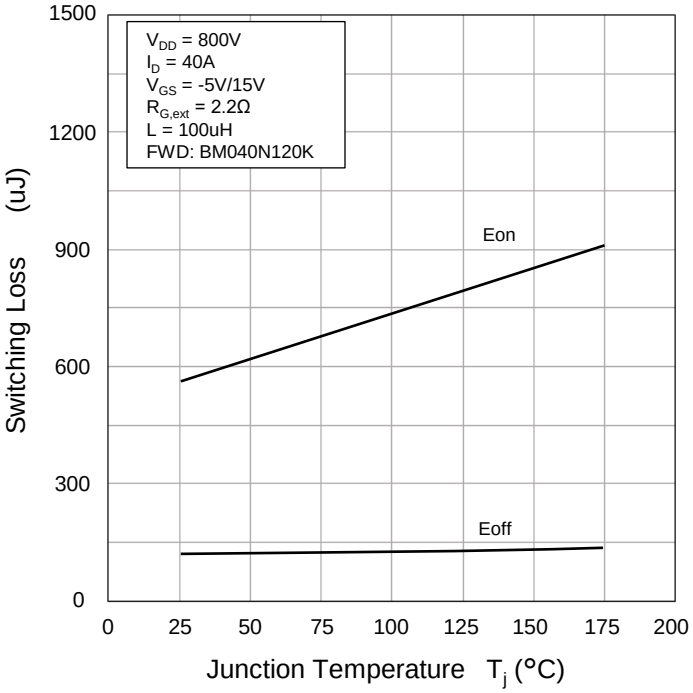


Figure 11 Typical Switching Loss vs. Junction Temperature

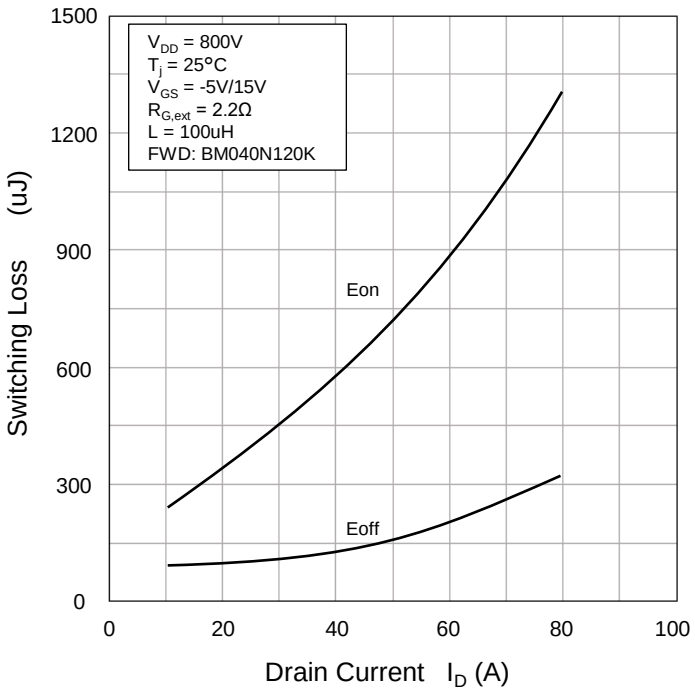


Figure 12 Typical Switching Loss vs. Drain Current (T_j = 25°C)

Electrical Characteristic Curves

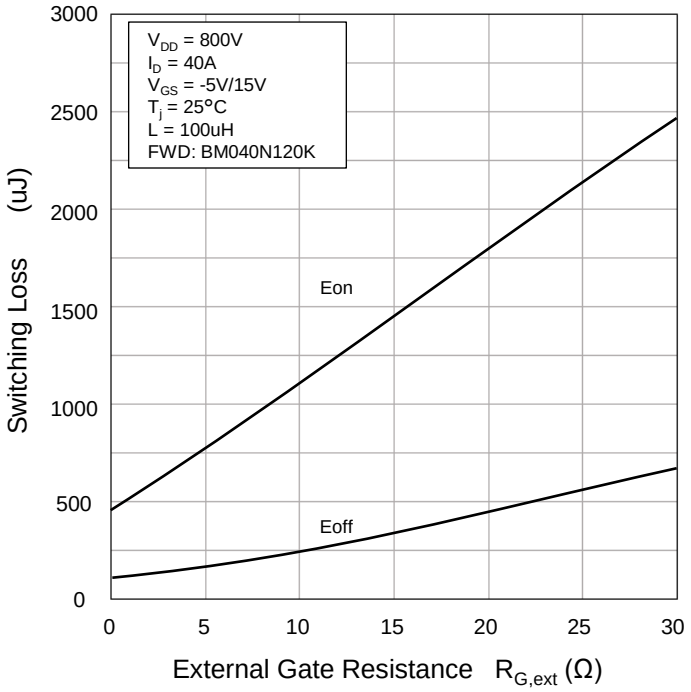


Figure 13 Typical Switching Loss vs. $R_{G,ext}$ (T_j = 25°C)

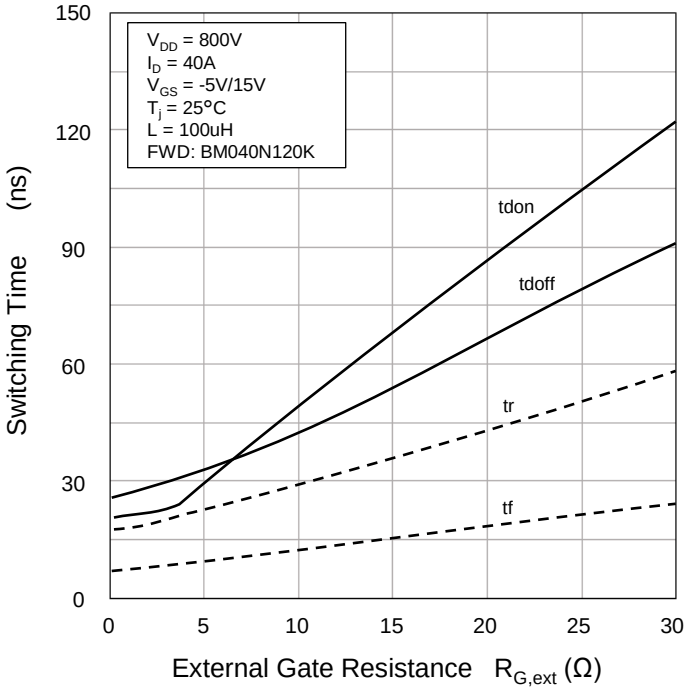


Figure 14 Typical Switching Times vs. $R_{G,ext}$ (T_j = 25°C)

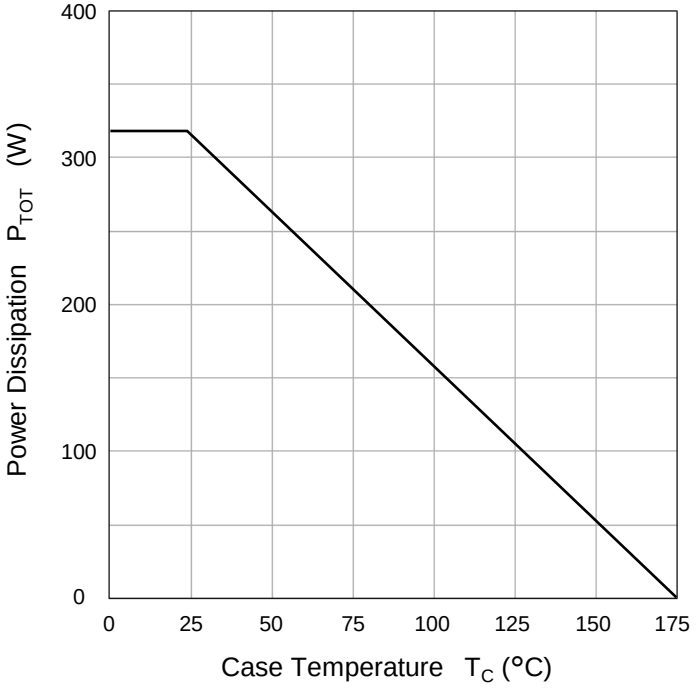


Figure 15 Maximum Power Dissipation Derating vs. Case Temperature

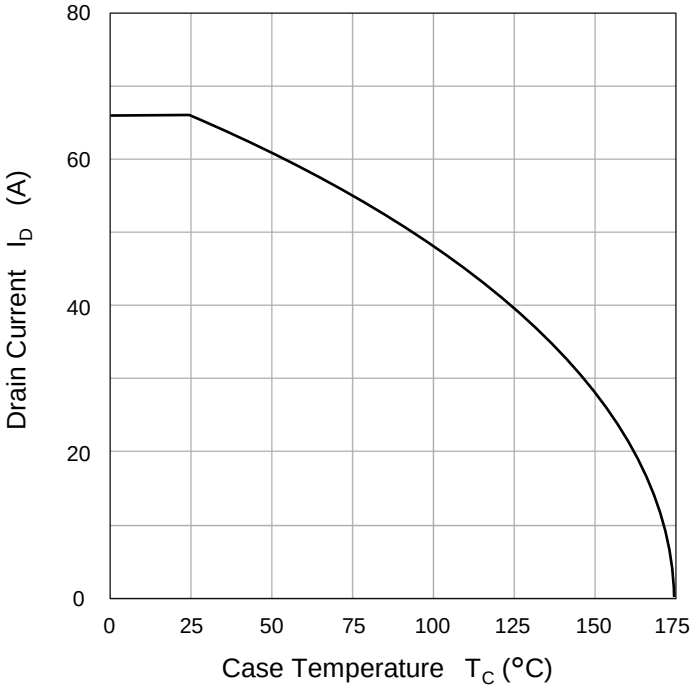


Figure 16 Maximum Continuous Drain Current vs. Case Temperature

Electrical Characteristic Curves

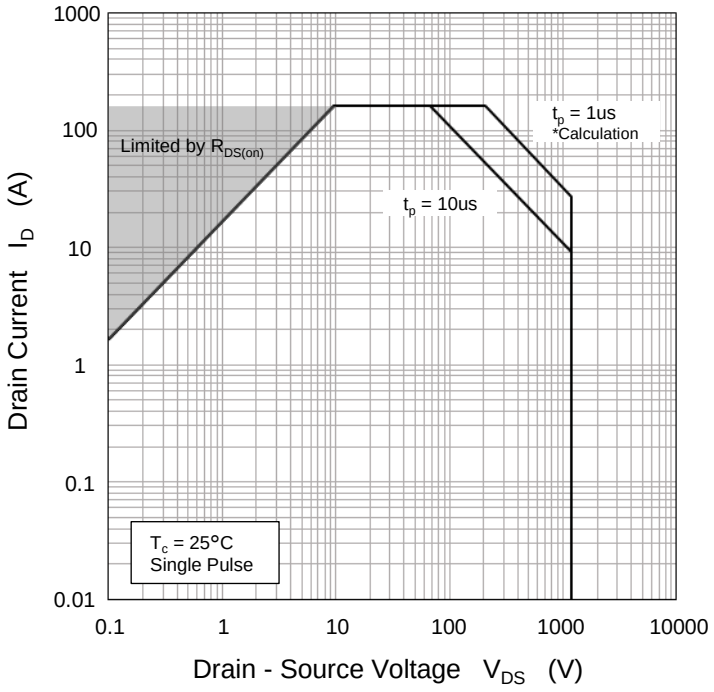


Figure 17 Maximum Safe Operating Area

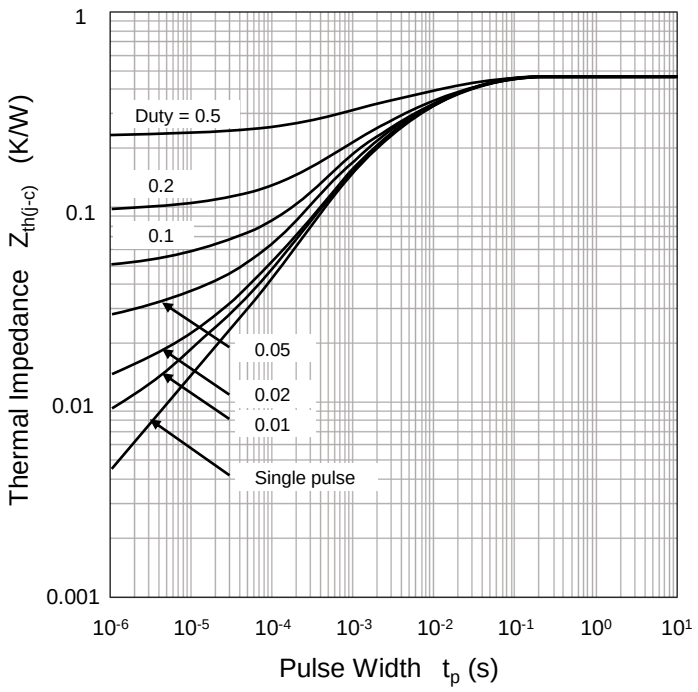
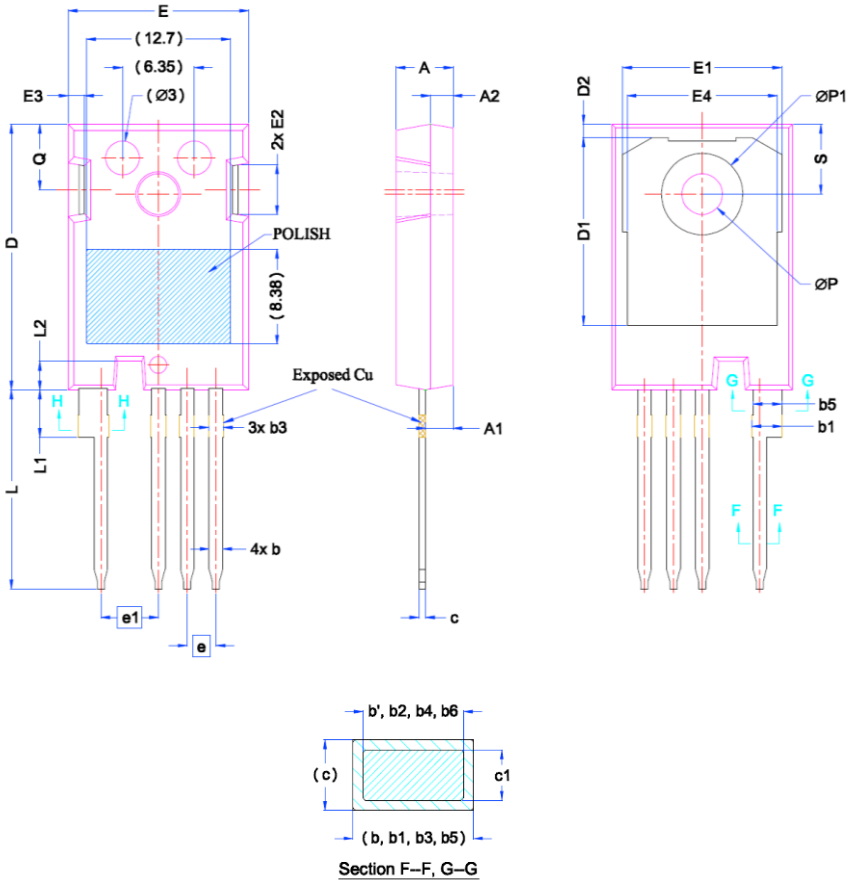


Figure 18 Maximum Transient Thermal Impedance vs. Pulse Width

Package Dimensions

TO-247-4 (unit : mm)



Section F–F, G–G

SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b2	2.39	2.67	2.84
b3	1.07	1.30	1.60
b4	1.07	1.30	1.50
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e		2.54 BSC	
e1		5.08 BSC	
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ØP	3.51	3.61	3.65
ØP1		7.19 REF.	
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

Important Notice

The information contained in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. This product has to be used within its specified maximum ratings, and is subject to customer's compliance with any applicable legal requirement, norms and standards.

Except as otherwise explicitly approved by Mitsubishi Electric Corporation in a written document signed by authorized representatives of Mitsubishi Electric Corporation, our products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

In usage of power semiconductor, there is always the possibility that trouble may occur with them by the reliability lifetime such as Power Cycle, Thermal Cycle or others, or when used under special circumstances (e.g. condensation, high humidity, dusty, salty, highlands, environment with lots of organic matter / corrosive gas / explosive gas, or situations which terminals of semiconductor products receive strong mechanical stress). Therefore, please pay sufficient attention to such circumstances. Further, depending on the technical requirements, our semiconductor products may contain environmental regulation substances, etc. If there is necessity of detailed confirmation, please contact our nearest sales branch or distributor.

The contents or data contained in this datasheet are exclusively intended for technically trained staff. Customer's technical departments should take responsibility to evaluate the suitability of Mitsubishi Electric Corporation product for the intended application and the completeness of the product data with respect to such application. In the customer's research and development, please evaluate it not only with a single semiconductor product but also in the entire system, and judge whether it's applicable. As required, pay close attention to the safety design by installing appropriate fuse or circuit breaker between a power supply and semiconductor products to prevent secondary damage. Please also pay attention to the application note and the related technical information.

Keep safety first in your circuit designs!

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

- These materials are intended as a reference to assist our customers in the selection of the Mitsubishi Electric Semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.
- Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
- All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Electric Semiconductor product distributor for the latest product information before purchasing a product listed herein.
- The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
- Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Electric Semiconductor home page (http://www.MitsubishiElectric.com/semiconductors/).
- When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
- Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Electric Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
- The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.
- If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
- Any diversion or re-export contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
- Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Electric Semiconductor product distributor for further details on these materials or the products contained therein.